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VOLCANOLOGY.—*The eruption of Santorini in 1925.*[1] H. S. WASHINGTON, Geophysical Laboratory, Carnegie Institution of Washington.

The small island group of Santorini, among the southernmost islands of the Greek Archipelago, is well known through the monumental work of Fouqué,[2] who described the island and its eruptions, especially that of 1866–70. I was able to study the present eruption during the 13th–20th of September last, in company with Prof. K. A. Ktenas, of the University of Athens and his assistant, Dr. P. Kokkoros. At the date of writing, three short notes on the early stages of the eruption, by Prof. Ktenas and others, have appeared.[3]

Since the explosion that formed the central lagoon in the original prehistoric volcano (Fig. 1), volcanic activity has been almost exclusively confined to a group of small islands in the center of the lagoon, the products of eruptions of different, and all historic, times (Fig. 2). The dates of the chief of these eruptions and the names given to the cones are as follows: Palaia Kaimeni,[4] 46 A. D.; Mikra Kaimeni, 1570 A. B.; Nea Kaimeni, 1707–1711 A. D.; and Giorgios Kaimeni, 1866–70. This last was in a feebly fumarolic state when I visited it in 1893. For the present volcano, Prof. Ktenas[5] has proposed the name Fouqué Kaimeni, in honor of the eminent French savant, and I gladly adopt his very appropriate name.

After some feeble, apparently preliminary, earthquakes at the end

[1] Received December 3, 1925.

[2] F. Fouqué, *Santorin et ses Éruptions*, Paris, 1879.

[3] K. A. Ktenas, C. R. Acad. Sci. **181**: 376. 1925; Georgalas and Liatsikas, ditto, p. 425; Ktenas, ditto, p. 518.

[4] *Kaimeni* (meaning burnt) is the modern Greek term for the volcanic cones. Palaia Kaimeni is not shown in Fig. 2.

[5] Ktenas, C. R. **181**: 377. 1925.

of July and during the first nine days of August, the eruption began on August 11,[6] and the volcano has been in a continuous state of activity

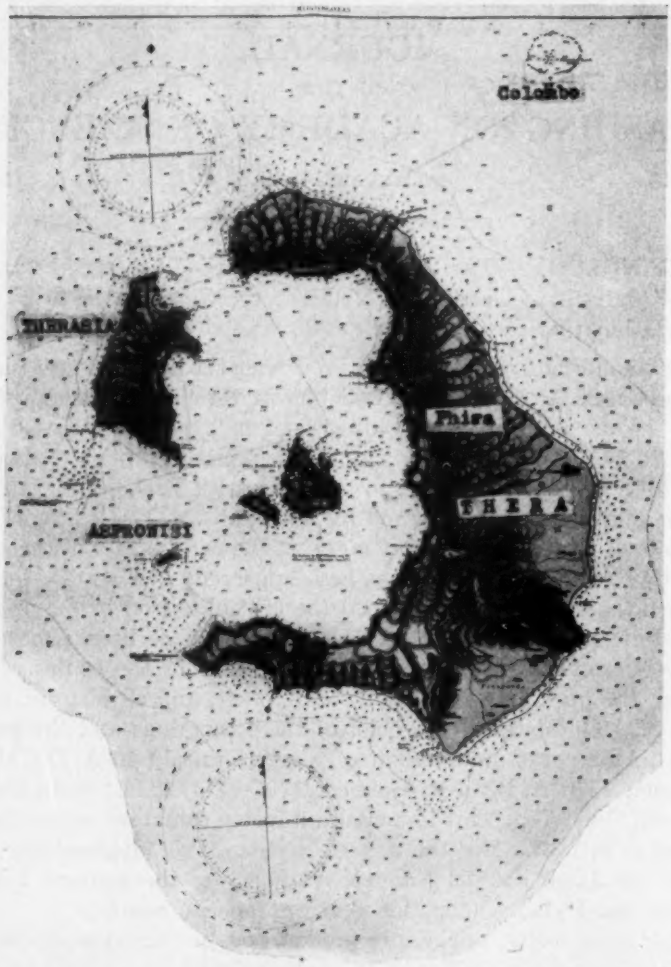


Fig. 1.—Map of the Santorini Group, prior to the eruption of 1925

ever since, or at least until October 27, according to a note kindly sent me by Prof. Ktenas. The initial center was submarine, in the strait

[6] For some details as to the early stages I avail myself of the data in the three papers cited above, in addition to information obtained during my visit.

between Mikra Kaimeni and Nea Kaimeni, and apparently about half way between their craters (x in Fig. 2). An islet was formed and lava flows were poured out, which flowed east and north in the narrow

Fig. 2.—The central islands of Santorini (from Fouqué, Plate XXIX), showing Fouqué Kaimeni (F. K.) and the two lava flows. September 19, 1925.

channel, gradually filling it and rising several meters above the previous water level. When I left September 20 the northern flow had practically ceased moving, but the eastern flow was slowly pushing out into the lagoon, and was still in motion on October 27. A small

lava flow also extended to the south, on the flat land east of the cone of Giorgios.

The lava flows were of the usual Santorini type—loose agglomerate of large and small, angular blocks. An immediate evidence of flow was that these blocks would fall down or tumble over each other from time to time, as the more continuous lava flow, of which they formed the upper part, moved slowly onward. Where the flows entered the lagoon the water was very hot. Dr. Kokkoros measured temperatures up to 69°, and at places near the flows the water was apparently boiling, or almost so. Much steam was given off, and at times there was a rather strong odor of H_2S from the water. Near this part of the shore the lagoon water was colored bright yellow or orange, from the hydrolytic precipitation of iron hydroxide.

The material of the lava flows and of the ejected blocks is a hypersthene andesite that in megascopic and microscopic appearance closely resembles the generality of the Santorini lavas, being dense, black, and highly vitreous. A chemical analysis by Miss Keyes shows that it contains 64.99 per cent of SiO_2, and that otherwise it is almost identical chemically with other lavas of Santorini, of different dates, that have been analysed.[7] A description of the petrographical and chemical features must await a later publication, but attention should be called here to the very remarkable and almost unique constancy in physical, modal, and chemical characters that the Santorini lavas exhibit, from the earliest times until the present day.

A good view of Fouqué Kaimeni was to be had with binoculars from the town of Phira, about 2 miles east-northeast. From this point the spectacle at night was magnificent. Near-by views of the dome were to be had from the lagoon, although these were not very satisfactory. Attempts to see and study the eruption from the summit of Nea Kaimeni and the north slope of Giorgios were frustrated by showers of stones, but finally on September 19 good view-points were found along the ridge of the easterly flow of Giorgios Kaimeni, about 500 meters from and about due south of the dome (S in Fig. 2).

From this ridge on September 19, Fouqué Kaimeni was seen to form a low circular dome, estimated by me to be nearly 150 meters in diameter and about 50 meters high.[8] During our stay its form changed continually, the summit being for a time flat and truncated, again

[7] Cf. H. S. Washington, C. R. XII Cong. Géol. Int., **235**. 1914.

[8] Ktenas (op. cit., **181**: 520. 1925) estimates the diameter at not over 100–120 meters and the height at about 75 meters. According to him the height of the lava flow in the strait is 20–48 meters above sea level. There would seem to have been some ascensional movement at the east end since my departure.

regularly domal, and again asymmetrical, with an apex at the west side. The dome appeared to be formed of a carapace of solid lava, much cracked and fissured, a brilliant red incandescence being visible at night, but only rarely during the day. The cracks and fissures were constantly altering their position and, although we thought that the dome was a more or less continuous carapace, yet it is possible that it consisted mainly of a mass of loose, piled up lava blocks. No definite crater was visible. The dome rested upon a plateau formed by the earlier lava flows and, to judge from the observations made on September 19 and from Ktenas' map, the center of activity had shifted, from its initial site in the strait, to a point a couple of hundred meters to the south, that is, onto the previously existing shore terrace. A battery of white-vapored fumaroles was in constant activity at the top of the east slope of Nea Kaimeni.

The volcanic activity of Fouqué Kaimeni was continuous but irregularly pulsatory in intensity, and there were at least three kinds of eruption, one being practically uninterrupted, while the other two were intermittent.

(1). From the north end of the Fouqué dome there rose almost continuously a vertical column of white or yellowish vapor, thin at the base and gradually expanding, that attained heights of about 200 meters or more. This gave rise to a loud hissing noise and was unaccompanied by the ejection of stones or ash. Another similar blast of white steam issued, with less force but with intermittent suddenness, from the southeast side of the dome, being projected upward at an angle of rather less than 45° from the horizontal.

(2). The most violent explosions were dominantly of Mercalli's vulcanian type, although there was, at times, some admixture of the strombolian. These spectacular ejections took place from or near the summit of the dome, but apparently not from a fixed point or crater. They occurred at irregular intervals, and consisted of a succession of huge puffs, generally accompanied by a loud and deep roar. Some were practically noiseless. The successive puffs, as at many other volcanoes, formed a thick column, of the usual "cauliflower" type, that attained varied heights, from 500 to 2000 meters and more, gradually thinning out and drifting to leeward at still greater heights. These cauliflower columns were white to dark gray in color, apparently composed very largely of water vapor, highly charged with gray lapilli, sand, and fine ash. There was a scarcely perceptible odor of H_2S at about 500 meters to leeward. The emission of the cauliflower columns was generally accompanied by the violent ejection of many solid blocks of lava, that attained heights of 200–300 meters, and often

much more. The stones were scattered in all directions and to considerable distances, some being found by us near the small harbor of St. George, about 600 meters to the west. It was reported that some had fallen on the shallow former anchorage, the "Banko," about one kilometer to the east, so that this was abandoned by shipping. In daylight most of the ejected stones appeared black, only a few being dull red; but at night they were brilliantly red, forming a magnificent spectacle, as has been said. These blocks varied much in size, from that of one's fist to lengths of 50, 60, or more centimeters. On impact with the ground they broke up, and there was further cracking from the strains set up as the glass cooled. We found no rounded bombs nor other masses evidently ejected in a fluid condition, nor were there any bread crust bombs. We could see no electrical discharges in the columns, either by day or by night.

(3). The third kind of explosion was most unusual—indeed, I can recall no record in the literature of anything exactly like it, although something similar appears to have occurred at Giorgios in April, 1866,[9] and the eruption of Novarupta, near Katmai in Alaska[10] may have presented some analogous features. The probable cause of the phenomenon will be discussed in a subsequent paper.

As studied with the glass from Phira at night, the foot of the dome of Fouqué Kaimeni was seen to be often partly surrounded by a thin ring of bright red incandescense, evidently an encircling crevice. Occasionally an outer brilliant concentric crevice was visible here and there. These crevices were not evident in the daytime from our viewpoint on September 19, but at intervals there issued from the site of the crevice, at the foot of the dome on the west and southwest sides, a semicircular or quarter-circular series or battery of narrow jets of white or light gray vapor. These jets always exploded simultaneously and formed a crown around the dome. They were approximately equidistant from each other, and not far apart—possibly not more than 10 to 20 meters. They reached altitudes of only about 50 or 100 meters, possibly a trifle more. It seemed that the emission of these series of jets usually preceded the great vulcanian explosions, or were at least coincident with them. I would venture to suggest that the technical term *coronet* be used for this type of volcanic explosion.

At night, from Phira, a few flames were to be seen playing over the dome. These were mostly bluish, but some were yellow or red. They were not visible in the daylight from points near the dome.

[9] Fouqué, op. cit., p. 75.

[10] Cf. C. N. Fenner, Jour. Geol. **28**: 588. 1920; and Tech. Papers Nat. Geogr. Soc., Katmai Series, **1**: 55. 1923.

The inhabitants of Phira and the other towns were somewhat panicky, fearing serious damage to buildings from the volcano or from earthquakes. In our opinion there is scarcely a possibility of danger that the towns on Thera and Therasia will suffer serious damage from the volcano, and probably not from earthquakes, although the vineyards may be damaged from falling ash, especially when the vines begin to burgeon in the spring.

As to the future, it appears to be probable, from analogy with other recent eruptions at Santorini, that the eruption of Fouqué will be of considerable duration—at least one year and probably several years.

ATOMIC PHYSICS.—*Note on the $L_{II}L_{III}$ levels of the atoms Si, P, S, Cl.* SAMUEL K. ALLISON. Geophysical Laboratory, Carnegie Institution of Washington.[1]

Many investigators have made measurements of the energy levels of atoms by means of experiments on the photo-electric effect of the radiations given off by these atoms when they are excited by various means. This method is particularly useful in the region between the softest X-rays which can be studied by crystalline diffraction and the shortest wave-lengths in the ultra violet which can be studied with gratings as in the experiments of Millikan.

In some cases it has been possible to compare the energy level values obtained by these photo-electric methods with those obtainable by the ordinary methods of X-ray spectroscopy, either directly, or by application of the combination principle. In the cases in which it has been possible to carry out such comparisons, it has often been found that no convincing agreements could be obtained. For instance, the measurements by Rollefson[2] of some critical potentials of iron which he ascribes to the L and M series are difficult to reconcile with the recent measurement of the $L\alpha$ and β lines of iron by Siegbahn and Thoraeus.[3]

It is the purpose of this note to call attention to the fact that recent X-ray measurements by Ray[4] and Bäcklin,[5] together with the older measurements of Lindh[6,7] make possible a rather rigid comparison between the two experimental methods for obtaining the L_{II} and L_{III} limits of Si, P, S, and Cl. The experiments of these investigators

[1] Received December 1, 1925.

[2] Rollefson, Phys. Rev. **23**: 35. 1924.

[3] Siegbahn and Thoraeus, Arkiv. f. Mat. Astr. Fys. **18**: No. 24. 1924. See also Siegbahn, *Spectroscopy of X-rays* (English Ed.), p. 238.

[4] Ray, Phil. Mag. **50**: 505. 1925.

[5] Bäcklin, Zs. f. Phys. **33**: 547. 1925.

[6] Lindh, Diss. Lund. (1923.)

[7] Lindh, Zs. f. Phys. **31**: 210. 1925.

make it clear that the energy levels of these light atoms depend in value on the particular chemical combination in which the atom is involved. From their results it is now possible to calculate the values of the L_{II} L_{III} levels of these atoms in different chemical combinations.

TABLE 1.—λ AND ν/R VALUES FOR K_{abs} AND $K\alpha_{1,2}$

ELEMENT	COMPOUND	$\lambda(X.U)^{K_1}$	ν/R	$K\alpha_1$	λ, ν/R	$K\alpha_2$	
14 Si	SiO_2	6707.5	135.85		7106.83	128.224	
	Si	6731.0	135.38		7109.17	128.182	
15 P	P_2O_5	5751.5	158.44		6141.71	148.374	
	P_{red}	5767.4	158.00		6144.43	148.308	
16 S	MSO_4	4987.9	182.70	5358.50	170.061	5360.90	169.984
	S	5008.8	181.93	5360.90	169.984	5363.90	169.889
17 Cl	$NaClO_4$	4369.4	208.56		(4715)	(193.3)	
	KCl	4382.9	207.92	4718.21	193.139	4721.18	193.017

The result of such a calculation is shown in the tables. The wavelengths have been obtained from the following sources. The K_1 critical absorption wave-lengths of the compounds of P, S, Cl, as well as of the elements themselves, are taken from the dissertation[6] of Lindh. The value for the K_1 limit of SiO_2 and Si was obtained by Lindh at a later date.[7] The wave-lengths of the unresolved $K\alpha$ doublet of Si, P in P_2O_5, and of the $K\alpha_1$ line of Cl in KCl have been taken from the early measurements of Hjalmar.[8]

Recently Bäcklin[5] has measured the doublet separation of these lines for Si and P in various compounds but apparently no new absolute measurements of the wave-lengths have been made. The wave-lengths of the $K\alpha$ doublet in sulfur and sulfates (MSO_4) have been taken from the work of Ray.[4] The wave-length of the $K\alpha_2$ line of Cl in KCl is obtained from $K\alpha$, by the recent measurement of Bäcklin[5] of the doublet separation. The wave-lengths of the unresolved $K\alpha$ doublet in SiO_2 and red P have been obtained from the old measurements of Hjalmar on Si and P_2O_5, by means of the results of Bäcklin[5] on the shift of these lines with varying chemical combination. A hypothetical wave-length for the unresolved $K\alpha$ doublet in Cl in $NaClO_4$ has been inserted on the assumption that a shift of the doublet

[8] Hjalmar, Phil. Mag. 41: 675. 1921.

of the same order of magnitude as found by Bäcklin between the lower and highest valences of Si, P, and S occurs. Due to this assumption an error of as much as 1 volt may be introduced into the L_{II} L_{III} levels of Cl in $NaClO_4$ in Table 3.

TABLE 2.—$\frac{\nu}{R}$ VALUES OF L LEVELS

ELEMENT	COMPOUND	L_{II}	L_{III}
14 Si	SiO_2	7.63	
	Si	7.20	
15 P	P_2O_5	10.07	
	P_{red}	9.69	
16 S	MSO_4	12.72	12.64
	S	12.04	11.95
17 Cl	$NaClO_4$	(15.3)	
	KCl	14.90	14.78

TABLE 3.—L LEVELS IN VOLTS

X-RAY SPECTRA				CRITICAL IONISATION VOLTAGE (HOLWECK)	
Element	Compound	L_{II}	L_{II}	Compound	L_{II} L_{III}
14 Si	SiO_2	103.4			
	Si	97.5		SiH_4	98 ± 2
15 P	P_2O_5	136.4			
	P_{red}	131.3		PH_3	128 ± 2
16 S	MSO_4	172.3	171.2		
	S	163.1	161.9	H_2S	163 ± 1
17 Cl	$NaClO_4$	(207)			
	KCl	201.8	200.2	HCl	203 ± 1

Holweck[9] has made measurements of the L_{II} L_{III} energy levels of the elements Si, P, S, Cl by an ingenious method which differs considerably from the usual photo-electric methods. It is essentially a measurement of the critical ionisation potential of gaseous compounds of these elements by increasing the highest frequency in a beam

[9] Holweck, Compt. rend. **180**: 658. 1925.

of X-rays partially absorbed in an ionisation chamber filled with a gaseous compound of the element in question until a sudden increase in the ion current through the chamber shows that a critical frequency has been reached. The skillful technique which enables this method to be applied to very soft X-rays has been described by Holweck. In this work the gaseous compounds SiH_4, PH_3, H_2S, and HCl were used. The results for the L_{II} L_{III} limits of Si, P, S, Cl in these compounds are given in Table 3, and are there to be compared with the values obtained from X-ray data for other compounds. Such a comparison has been indicated by Turner.[10] The X-ray data available at that time indicated a discrepancy between the results of Holweck and X-ray predictions, but it will be seen that the present agreement is good.

It is evident from Table 3 that the X-ray data indicate an energy difference in volts between the $L_{II}L_{III}$ levels of these atoms in their highest and lower valencies which is greater than the experimental error which Holweck ascribes to his measurements, and in fact his data agree well with the lower valencies (in Si, P, S with the elements themselves) and disagree definitely with the higher valency values.

The necessity of taking account of the particular chemical compound involved in seeking agreement between data in this region has been emphasized by Siegbahn.[11]

The agreement between Holweck's measurements on the hydrides and the X-ray values for the free elements in the case of Si, P, S, indicates that the difference between the energy level values of the hydrides and those of the free element is much less than that between those of the free element and its higher "positive" valence compounds with oxygen. Such a result is perhaps not at variance with modern chemical ideas as to the type of linkage in these compounds.

SUMMARY

By application of the combination principle it is possible to calculate the energy values of the L_{II} L_{III} levels in the atoms Si, P, S, Cl in various compounds from recent X-ray data. The resulting values are compared with a determination of these levels in the hydrides of these atoms which was carried out by Holweck by photo-electric methods. The results show that for Si, P, S these levels have very nearly the same energy in the hydrides as in the elementary substance itself, but that in the higher oxides of these elements there is an appreciable difference in this respect between the element and oxide.

[10] Turner, Phys. Rev. 26: 143. 1925. (Footnote p. 145.)
[11] Siegbahn, Spectroscopy of X-rays (English Ed.) p. 241.

BOTANY.—*A new circumneutral soil prickly-pear from the Middle Atlantic States.* EDGAR T. WHERRY, Bureau of Chemistry.

In the course of studies upon the relation between soil reaction and the distribution of native plants, the prickly-pears of the northeastern states have received some attention, and evidence has been found that, instead of the single species listed by Britton and Rose,[1] there are actually at least four species represented in this region. One of these appears to have been hitherto unrecognized, and the name *Opuntia calcicola* is here proposed for it, in reference to its frequent growth on calcareous rocks. The differences between them may now be considered.

ACID-SOIL SPECIES

Opuntia compressa.—The most widespread of these prickly-pears is the one long known as *Opuntia vulgaris* Miller, now believed to be more correctly designated as *Opuntia opuntia* (L.) Karsten under codes permitting duplicate binomials, or preferably as *O. compressa* (Salisbury) Macbride. The center of distribution of this species appears to be in the Piedmont of Virginia and adjoining states; it ranges southward to an as yet unknown distance—possibly though not certainly into the Applachian Plateau province in Alabama—and northward into the Appalachian Valley province of central New York state, the northern Coastal Plain in New Jersey, and the New England Upland in Connecticut and Massachusetts. In all of these regions it grows in rocky or sandy soil which shows a distinctly or often a strongly acid reaction (subacid to mediacid).

This is a prostrate plant with fibrous roots; the joints are orbicular to oblong, averaging 8 to 10 cm. long, rather thick in proportion to their length (except in shaded situations, when they may become much elongated and thinned), and in color (following Ridgway's Color Standards) dull grayish green-yellow, either "jade green" (27″ k) or adjacent hues; the leaves are 4 to 5 mm. long, and more or less appressed; slender brown and white-banded spines, about 0.8 mm. thick and 2 cm. long, are occasionally present, one or rarely two to an areole; the numerous glochids are pale dull orange-yellow, near "deep colonial buff" (21″b); the flowers are pure yellow ("lemon yellow", 23), and about 7 cm. in diameter, with 8 or 10 petals; the fruit is obovoid, 3 to 4 cm. long and 1.5 to 2.0 cm. in diameter at the top, more than twice as long as wide only exceptionally in crowded situations; and the seeds are 4 to 5 mm. broad, with a prominent roundish keel.

Opuntia pollardii.—Though usually recorded as limited to the southern states, this species actually extends at least as far north as eastern Maryland and Delaware, if not into New Jersey, growing typically in the subacid to mediacid Coastal Plain sands. It is distinguished from the preceding by having sweet-potato-like thickenings on its roots; thick and stubby joints of

[1] Britton and Rose, *The Cactaceae* 1: 127. 1919.

somewhat more bluish green color (near "cress green", 29″k); more spreading leaves; stouter spines 1.5 to 2 mm. thick and 2 to 4 cm. long; and seeds having an even thicker keel.

Circumneutral-Soil Species

Opuntia humifusa.—Though sometimes included under *Opuntia compressa*, the plant from west of the Appalachian Mountains, ranging over the Interior Low Plateau and Central Lowland provinces, from Tennessee to Illinois and Ohio, has several features which distinguish it. It appears to be limited to limestone rock ledges and calcareous gravel. It grows more erect, with larger and relatively thinner joints, usually bearing a glaucous coating, so that their color is near "deep dull yellow green" (31″k), although old joints from which the glaucous coating has disappeared may be similar in hue to those of *O. compressa;* the areoles are fewer and more widely spaced; the leaves are longer and more spreading; 3 to 5 cm. spines are frequently developed; the glochids are strikingly different, being orange-brown in color, near "ferruginous" (9′i) when fresh, becoming "tawny" (13′i) with age; the flowers often have a red center, owing to a triangular blotch of orange-red ("scarlet," 5) at the base of each petal; and the fruit is normally longer in proportion to its width.

Opuntia calcicola Wherry, sp. nov.—Growing on limestone and in other circumneutral soils in the Appalachian Valley and adjacent portions of other provinces, there is another type of prickly pear, which lies in many respects intermediate between *O. compressa* and *O. humifusa* yet seems sufficiently distinct from either to justify its separation. Its characters are as follows:

Plants ascending, with fibrous roots. Joints oblong to obovate, mostly from 7 to 21 cm. long, 4 to 8 cm. wide, and 5 to 9 mm. thick; color a dull grayish yellow-green, ranging from about "chromium green" (31″i) on young joints bearing more or less glaucous coating, to "krönbergs green" (25″k) on old ones. Areoles few and widely spaced. Leaves spreading, early deciduous, 6 to 8 mm. long and 1.5 mm. thick, dull green-yellow, around "mignonette green" (25″i), toward the tip often of a dull orange-brown, such as "sayal brown" (15″i) or a similar color. Spines none, except for a few small whitish ones on seedling plants. Glochids numerous, pale grayish orange-yellow approximating to "chamois" (19″b). Wool similar in hue to glochids, but paler, near "cartridge buff" (19″f). Flowers numerous, 7 to 10 cm. broad, opening during June; petals 10 to 14, pure yellow ("lemon yellow," 23). Stamens about 150, 1.5 to 1.8 cm. long; filaments somewhat more orange-colored than petals, often "lemon chrome" (21); anthers pale whitish yellow, "ivory yellow" (21″f). Style 1.8 to 2.2 cm. long, more or less yellow-colored; stigma lobes 3 mm. long, yellowish gray. Fruit slender obovoid, normally 3.5 to 4.5 cm. long by 1.2 to 1.5 cm. wide at the top, thus three times as long as thick; on ripening becoming dull grayish red, "hay's maroon" (1′m) and adjacent colors; seeds 4.5 to 5 mm. in diameter, 2.5 to 3 mm. thick, with an acute-edged keel rather less prominent than in its relatives, in color grayish orange-yellow, near "clay color" (17″).

As the type locality may be designated an occurrence on the west side of the

B. & O. R. R. tracks, a short distance north of Bolivar, Jefferson County, West Virginia. Type specimens, collected here on June 9, 1925, have been deposited in the U. S. National Herbarium (no. 1,242,156, type) and the New York Botanical Garden. The photograph reproduced as figure 1 was taken at that time and place, and brings out the lack of spines and the long fruit.

This plant has been thus far observed at the following localities: On limestone at two places about 2 km. (1.5 miles) north of Luray (in one locality covering several acres) and at Overall, Page County, Virginia; on brown shale (Devonian) at several places in the vicinity of Moorefield, Hardy County,

Fig. 1. Opuntia calcicola Wherry, new species

West Virginia; on shaly limestone along B. & O. R. R., at Martinsburg, Berkeley County, West Virginia; on dolomitic limestone near Bolivar, Jefferson Co., West Virginia (type locality); on red shale (Triassic) 6 km. (4 miles) south-southwest of Poolesville, Montgomery County, Maryland; and on limestone near Mechanicsburg, Cumberland County, Pennsylvania. Soil reaction ranging from specific acidity 10 to specific alkalinity 10, thus typically circumneutral. In the report on the Living Flora of West Virginia by Millspaugh, published by the state in 1913, the occurrence at Moorefield is referred to in the tabulation (p. 309) as *Opuntia Opuntia*, but in the introduction (p. 15) as the western *Opuntia polyacantha;* as the latter species, true

to its name, bears numerous spines, while the West Virginia plant has none at all, this was a curious case of misidentification.

Opuntia calcicola differs, then, from its relative, *O. compressa*, in often growing on limestone, or in any case on rocks yielding circumneutral soils, in being more upstanding in habit, in having longer and relatively thinner joints of somewhat more bluish color, in the areoles being wide-spaced, and in lacking spines. The flowers are similar in color but larger, and the fruit is normally decidedly longer in proportion to its thickness, the seeds having a more acute and less prominent keel. Even allowing for some variation in these respects shown by the widespread *O. compressa*, the distinctness of the two seems evident. After the aspect of these plants is once in mind, as a result of observing them at one or two typical localities, it is possible to tell which is represented in a given colony from a considerable distance, and this may be regarded as a final criterion of the separateness of the species.

BOTANY.—*New plants from Chiapas collected by C. A. Purpus.*[1]

PAUL C. STANDLEY, U. S. National Museum.

The nine species of plants here described as new form part of a large and interesting collection made in the State of Chiapas, Mexico, in 1925 by Mr. C. A. Purpus. Mr. Purpus' Mexican collections are too well known to need comment. Many of the new species found in them were described by the late Townshend S. Brandegee in a series of papers entitled "Plantae Mexicanae Purpusianae," the last of which was issued in 1924.[2]

Neea chiapensis Standl., sp. nov.

Branchlets terete, pale brownish, minutely and densely grayish-puberulent at first but quickly glabrate; leaves opposite, or the upper verticillate, the petioles slender, 1.2–3 cm. long, glabrate, the blades elliptic or broadly elliptic, 7.5–15 cm. long, 4.5–7 cm. wide, abruptly acute or acuminate, at base acutish or abruptly acute, rarely rounded, thin, glabrous, the lateral nerves very slender, about 7 on each side, arcuate, laxly and irregularly anastomosing near the margin; pistillate inflorescence few-flowered, on a slender peduncle 5 cm. long; fruit elliptic-oblong, 18 mm. long, 9 mm. thick, the stone compressed, coarsely costate.

Type in the U. S. National Herbarium, no. 1,208,246, collected in a ravine in mountains east of Monserrate, Chiapas, Mexico, April, 1925, by C. A. Purpus (no. 271).

No. 414, from the same locality, is perhaps referable here, but in this the leaves are much smaller. The fruit is immature.

All the Central American species of *Neea* are closely related. This one is similar in most respects to *N. psychotrioides* Donn. Smith, but in that the leaves are relatively narrower and shorter-petioled, and the fruit only half as large.

[1] Published by permission of the Secretary of the Smithsonian Institution.

[2] Univ. Calif. Publ. Bot. **10**: 403–421.

Zanthoxylum tenuipes Standl., sp. nov.

Branchlets unarmed or bearing stout broad-based prickles 1 cm. long; petioles terete, 2–3 cm. long; leaves odd-pinnate, the rachis setulose-hirtellous, the leaflets 5–9, opposite or the lower sometimes alternate, sessile or nearly so, ovate to oblong-elliptic, 3.5–6 cm. long, 1.5–3 cm. wide, acute or obtuse, thin, remotely and very shallowly glandular-crenate or subentire, deep green and somewhat lustrous above, paler beneath, sparsely setulose-hirtellous on both surfaces; inflorescences axillary, lax, few-flowered, paniculate, much shorter than the leaves, slender-pedunculate, the branches very slender, sparsely setulose, the pedicels almost filiform, 6–8 mm. long, glabrous; follicle 1, very oblique, produced at base, glabrous, coarsely glandular-punctate, 5 mm. long; seeds black and shining, 4 mm. long, sharp-edged.

Type in the U. S. National Herbarium, no. 1,208,237, collected in rocky gulch in mountains east of Monserrate, Chiapas, Mexico, July, 1925, by C. A. Purpus (no. 126).

Perhaps related to *Z. mollissimum* (Engler) P. Wilson, but easily recognized by the very long and slender pedicels and scant pubescence.

Buddleia purpusii Standl., sp. nov.

Branches quadrangular, densely stellate-tomentose, the tomentum loose, whitish or fulvescent; leaves sessile, lanceolate, 6–8.5 cm. long, 1.7–3 cm. wide, attenuate to an acute apex, cuneate at base, finely serrate-dentate with acute teeth, entire toward the base, green above, gland-dotted and rather finely stellate-tomentose, the venation impressed, beneath densely tomentose with a tomentum of loose whitish hairs; flowers sessile in dense few-flowered heads, the heads spicate, the spikes panicled; spikes 2–5 cm. long, about 8 mm. thick, sessile, interrupted below, dense and continuous above, often branched; calyx densely stellate-tomentose, the lobes 1–1.5 mm. long, narrowly triangular; corolla densely tomentose outside, 2 mm. long, the lobes ovate-triangular, obtuse; capsule densely tomentose, equaling the calyx lobes.

Type in the U. S. National Herbarium, no. 1,208,235, collected along creek near Monserrate, Chiapas, Mexico, March, 1925, by C. A. Purpus (no. 160).

Jacquemontia mollissima Standl., sp. nov.

Woody vine, the stems red-brown, with few large pale lenticels, when young densely stellate-tomentose with lax spreading hairs; petioles 3–7 mm. long; leaf blades ovate or oval-ovate, 1.5–3 cm. long, 1–2 cm. wide, acute to rounded at apex, sometimes apiculate, rounded or subcordate at base, above densely stellate-pilose, the hairs very slender, long, and soft, with few rays, beneath densely tomentose with long soft whitish hairs; flowers few, solitary or fasciculate in the leaf axils, the pedicels 2–3 mm. long; sepals 3–3.5 mm. long, oval or rounded, rounded at apex, the outer ones densely tomentose; corolla (probably white) 8–10 mm. long, glabrous.

Type in the U. S. National Herbarium, no. 1,208,236, collected on creek banks at Monserrate, Chiapas, Mexico, March, 1925, by C. A. Purpus (no. 47).

In general appearance this plant suggests *J. nodiflora* (Desr.) Don, but in that the sepals are glabrous, and the tomentum of the leaves fine and close.

Columnea purpusii Standl., sp. nov.

Small epiphytic shrub, the branches very stout, pale brownish or ochraceous, leafy near the tips, sparsely pilose with appressed or ascending hairs;

petioles 4–8 mm. long, densely villous-pilose with ascending, septate, whitish or purplish hairs; leaf blades narrowly elliptic-oblong or lance-oblong, 4–9.5 cm. long, 1–2 cm. wide, acute or acuminate, at base obliquely acute, glabrous above, beneath paler, sparsely setose-pilose along the nerves with pale appressed hairs, sometimes with a few appressed hairs between the nerves, the lateral nerves 3 or 4 on each side, ascending at an acute angle; flowers solitary in the leaf axils, the pedicels 4–12 mm. long, villous-pilose; calyx lobes narrowly lanceolate, rounded at base, 16–18 mm. long, 3–4 mm. wide, attenuate to an acute apex, ciliate, sparsely appressed-pilose outside, entire; corolla bright red, rather densely shorter-villous, the tube 4.5–5 cm. long, 7–9 mm. broad in the throat, the upper lip 2.5–3 cm. long, straight, the lower lip 1.5 cm. long, linear-lanceolate, recurved, the lateral lobes about 1 cm. long, obtuse; anther sacs 2.5 mm. long.

Type in the U. S. National Herbarium, no. 1,208,240, collected in damp forest in mountains near Fenix, Chiapas, Mexico, April, 1925, by C. A. Purpus (no. 239). No. 96 from the same locality also represents the species.

Only three species of *Columnea* have been reported from Mexico. *C. flava* Mart. & Gal. has yellow flowers. *C. erythrophoea* Decaisne is closely related to *C. purpusii*, but has cordate and dentate, rose-colored calyx lobes. *C. schiedeana* Schlecht. is distinguished from the present plant by its spotted corolla and copiously pubescent leaves.

Columnea stenophylla Standl., sp. nov.

Small epiphytic shrub, the branches reddish or pale brownish, when young pilose with stiff, appressed or ascending, septate hairs; petioles stout, 3–5 mm. long, pilose; leaf blades linear-lanceolate to linear, 6–9.5 cm. long, 0.5–1.5 cm. wide, long-attenuate, obliquely acute at base, glabrous above, beneath paler, sparsely pilose with very slender, long, appressed, lustrous hairs, the lateral nerves inconspicuous; pedicels axillary, solitary, 4–8 mm. long, pilose with ascending hairs; calyx lobes lanceolate or linear-lanceolate, 15–18 mm. long, 2.5–5 mm. wide, long-attenuate, rounded at base, entire, green, densely appressed-pilose with very slender, whitish, multiseptate hairs; corolla bright red, densely villous with very long, slender, spreading, red hairs, the tube 4.5 cm. long, 9 mm. wide in the throat, the upper lip broadly oblong, rounded at apex, 3 cm. long, 1.3 cm. wide, the lower lip triangular-oblong, 1.5 cm. long, acutish, the lateral lobes obtuse, 1–1.5 cm. long.

Type in the U. S. National Herbarium, no. 567513, collected at Finca Irlanda, Chiapas, Mexico, June, 1914, by C. A. Purpus (no. 7206). Collected also at Cafetal Copalito, Oaxaca, May, 1917, by Blas P. Peko (no. 3894).

A relative of *C. purpusii* but distinguished by the narrow leaves and the long pubescence of the corolla.

The species of *Columnea* are among the most beautiful plants of tropical America because of the large, brightly colored (usually red) flowers. Only a few species reach the mountains of southern Mexico, but in Costa Rica the genus attains probably its greatest development, and the number of species occurring there is very large.

Hillia chiapensis Standl., sp. nov.

Small epiphytic shrub, glabrous throughout; stipules oblong to obovate, 3–4 mm. long, rounded at apex, caducous; petioles 2 mm. long or less; leaf

blades elliptic or oblong-elliptic, 9–14 mm. long, 4–7 mm. wide, rounded at apex, obtuse or acutish at base, fleshy, the lateral nerves inconspicuous, ascending at very acute angle; capsule subsessile, 17–22 mm. long, the valves after dehiscence 3–4 mm. wide.

Type in the U. S. National Herbarium, no. 1,208,244, collected in damp forest in mountains near Fenix, Chiapas, Mexico, April, 1925, by C. A. Purpus (no. 262).

Of the three other species of *Hillia* known from North America, only *H. tetrandra* Swartz could be confused with this Mexican plant. That species is much larger in all its parts, and I have no doubt that the Chiapas plant, although represented only by incomplete material, is specifically distinct.

Psychotria chlorobotrya Standl., sp. nov.

Branches green, subterete, glabrous, smooth; stipules distinct, green, herbaceous, persistent, glabrous, broadly triangular-ovate, 5 mm. long, bilobate to the middle, the lobes acute; petioles slender, 1.5–4.5 cm. long, remotely and minutely puberulent or glabrous; leaf blades narrowly elliptic to lance-elliptic or oblanceolate, 8–23 cm. long, 2–7 cm. wide, long-acuminate, acute at base or usually long-attenuate, thin, bright green above and glabrous, beneath slightly paler, glabrous or along the nerves sparsely and obscurely puberulent, the lateral nerves 12–16 pairs, divergent at an angle of 45° or more, arcuate, obscurely anastomosing near the margin; inflorescence terminal, cymose-paniculate, dense, many-flowered, the peduncles 2–3 cm. long, puberulent, the panicles 1.5–4.5 cm. long, the flowers in dense headlike cymes on puberulent peduncles 1 cm. long or shorter; bracts ovate, green, obtuse or acute, 5–8 mm. long; bractlets broadly ovate to obovate, obtuse, green, glabrous or nearly so, much exceeding the calyx; calyx about 2 mm. long, 5-lobate, the lobes about 1 mm. long, ovate or deltoid, obtuse or acute, unequal, green, glabrous; corolla salverform, 4 mm. long (not fully developed), glabrous, with short obtuse lobes.

Type in the U. S. National Herbarium, no. 1,208,242, collected in damp forest in mountains near Fenix, Chiapas, May, 1925, by C. A. Purpus (no. 104). No. 83, from the same locality, also is referable here.

The species is well marked among those of Mexico by the large green bractlets, which nearly conceal the flowers.

Psychotria phoeniciana Standl., sp. nov.

Branches subterete, glabrous; stipules persistent, intrapetiolar, bilobate, united, the sheath 3 mm. long, the lobes obliquely ovate or triangular, acute, glabrous; petioles slender, 2.5–5 cm. long, glabrous; leaf blades oblong-lanceolate to ovate-lanceolate, 10–17 cm. long, 3.5–4.5 cm. wide, acuminate, cuneate-acute at base or sometimes abruptly acute, thin, glabrous, slightly paler beneath, the lateral nerves about 17 pairs, divergent at an angle of about 60°, arcuate, laxly anastomosing near the margin; inflorescence terminal, glabrous, the penduncle 15 cm. long, curved, the flowers very numerous, corymbose-paniculate, the panicle much branched, 10 cm. long, 15 cm. broad, the pedicels slender, 10–15 mm. long; bracts triangular, acute, 1–2.5 mm. long, the bractlets minute; calyx limb scarcely 1 mm. long, 5-lobed to the middle, the lobes ovate, obtuse, glabrous; fruit oval, 5 mm. long, 4 mm. thick, 10-costate, the nutlets concave and sulcate on the inner face.

Type in the U. S. National Herbarium, no. 1,208,247, collected in damp forest in mountains near Fenix, Chiapas, Mexico, May, 1925, by C. A. Purpus (no. 316).

Although not marked by any outstanding characters, unless it be the large inflorescence and long pedicels, this plant seems distinct from any *Psychotria* of Mexico or Central America that is known to the writer.

ENTOMOLOGY.—*New termites from Guatemala, Costa Rica, and Colombia.* THOS. E. SNYDER, Bureau of Entomology, U. S. Department of Agriculture.

The seven new termites described in this paper were collected by Dr. W. M. Mann, of this Bureau, in the winter and spring of 1924, and by Mr. F. Neverman, of Costa Rica, late in 1924 and in 1925; a portion of this material has already been described.[1] In addition to descriptions of the new species, new geographical distribution records of known termites based on these collections are given.

Most of the new species represent "powder-post" termites or potential house termites, and may become of economic importance. The writer uses the term powder-post termites for certain groups in the family Kalotermitidae; the impressed pellets of finely digested, excreted wood fall from wood infested by these termites and reveal their presence. Such termites must be rigidly excluded and guarded against by Federal quarantines; they are likely to be introduced in furniture, and become cosmopolitan in distribution. *Kalotermes* (*Cryptotermes*) *brevis* Walker occurs from Florida in the United States to the West Indies, Central and South America, and South Africa.

Powder-post termites live in hard dry wood and are difficult to collect, hence, since they are not conspicuous, many new species are being found when specially sought after by such excellent collectors as Dr. Mann and Mr. Neverman. No single specimen was definitely designated as a holotype; since the specific descriptions were made from a series, these specimens are cotypes.

Family KALOTERMITIDAE

Kalotermes (*Rugitermes*) **costaricensis,** new species

Winged adult.—Head yellow-brown (light castaneous-brown), smooth, shining, longer than broad, sides almost parallel, rounded posteriorly, with fairly dense long hairs. Postclypeus white, tinged with yellow, short but broad. Labrum light yellow-brown, broader than long, broadly rounded to

[1] SNYDER, T. E.: *New American termites.* This JOURNAL **15**: 152–162. 1925.

nearly straight at apex, with long hairs. Eye black, not round, fairly large and projecting, separated from lateral margin of head by a distance greater than the diameter of an eye. Ocellus hyaline, projecting, suboval, at an oblique angle to eye, from which it is separated by a distance equal to the long diameter of the ocellus.

Antenna light yellow-brown, whitish towards apex, with 17 to 20 segments; segments bead-like, or wedge-shaped, but becoming longer and broader toward apex; with long hairs; third segment longer than or subequal to second, but longer than fourth segment; last segment narrow, elongate, subelliptical.

Pronotum yellow (margins darker), not twice as broad as long, broadest at middle, roundly and shallowly concave both anteriorly and posteriorly; sides round, narrowed posteriorly, with scattered long hairs and denser short hairs.

Wings smoky dark brown, coarsely punctate. In forewing, median vein uniting almost directly with the radial sector; radial sector close to and parallel, and with seven branches to costal vein, first four long and oblique, others short; cubitus running parallel to radial sector, above middle of wing, to apex, with 11 branches or sub-branches to lower margin of wing; subcostal vein uniting with costa before middle of wing; seven irregular to crescentic transverse branches between cubitus and radial sector. In hind wing, median vein lacking; radial sector with two long and two short branches to costal vein; cubitus running to apex of wing with 10 branches or sub-branches to lower margin of wing: subcostal vein uniting with costa at about middle of wing; five irregular transverse branches between cubitus and radial sector.

Wing scale as long as pronotum.

Legs dark brown to fuscous (tarsi lighter), elongate, slender, hairs long.

Abdomen with tergites golden-yellow; tergites with fairly dense and fairly long hairs near base of each; cerci fairly elongate and prominent.

Measurements.—Length of entire winged adult, 11.5–12.25 mm.; length of entire deälated adult, 9–10 mm.; length of head (to tip labrum), 2.1 mm.; length of pronotum (where longest not at median line), 1.2 mm.; length of forewing, 8 mm.; length of hind tibia, 1.5 mm.; diameter of eye (long diameter), 0.37 mm.; width of head (at eyes), 1.8 mm.; width of pronotum, 2.05 mm.; width of forewing, 2.5 mm.

Soldier.—Head yellow-brown (light castaneous-brown, darker anteriorly and lighter posteriorly), cylindrical, markedly broadest anteriorly, sides slightly concave, with scattered long hairs, very dense on frontal slope or epicranial suture, where there is a median depression or groove. Eye spot hyaline, prominent, reniform, parallel to antennal socket. Gula about half as wide at middle as where widest anteriorly.

Mandibles black, base reddish-brown, broad at base, tips more slender, but fairly broad, pointed and incurved; left mandible with two fairly large sharp pointed marginal teeth on apical third, a small pointed tooth, a molar in the middle and a small blunt tooth near the base; right mandible with two large pointed marginal teeth, one in middle, the lower nearer the base; edge of right mandible roughened between apex and first tooth (Fig. 1).

Antenna yellow-brown to castaneous (lighter towards apex); with 15 segments, segments wedge-shaped, becoming longer and broader toward apex, with long hairs; third segment dark, markedly subclavate, longer than second or fourth segments; fourth segment about half as long as second; last segment elongate, slender, spatulate.

Pronotum yellow (margins darker), not quite twice as broad as long, broadest slightly anterior to middle; anterior margin broadly and roundly

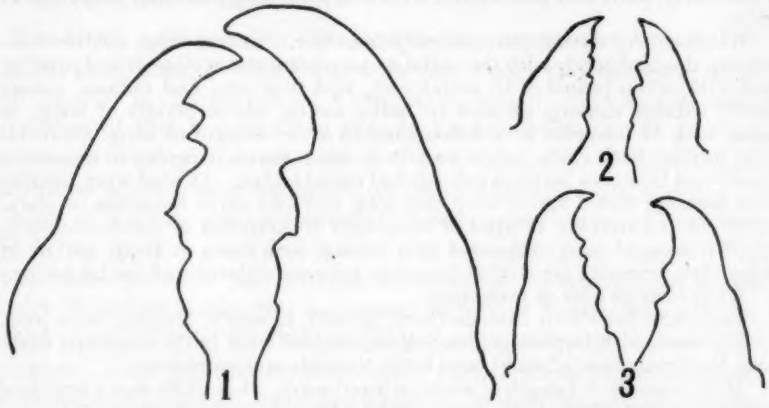
concave; generally convex posteriorly except at middle where shallowly emarginate; sides narrowed posteriorly; pronotum with dense, fairly long hairs.

In some specimens, meso- and meta-nota with short wing pads.

Legs tinged with yellow; femora markedly swollen; three dark-colored spines at apex of tibiae.

Abdomen with tergites yellow to light yellow-brown; a row of fairly long hairs at base of each; cerci fairly elongate; styli present.

Measurements.—Length of entire soldier, 10–12.5 mm.; length of head with mandibles, 5.25 mm.; length of head without mandibles (to anterior margin), 3.5 mm.; length of left mandible, 1.8 mm.; length of pronotum, 1.45 mm.; length of hind tibia, 1.2 mm.; width of head (anteriorly), 2.1 mm.; width of head (posteriorly), 1.7 mm.; height of head at middle, 2 mm.; width of pronotum, 2.8 mm.



New species of Kalotermes. Mandibles of soldiers showing marginal teeth. (Camera lucida, high power.)

Fig. 1.—*Kalotermes* (*Rugitermes*) *costaricensis* Snyder
Fig. 2.—*Kalotermes* (*Calcaritermes*) *asperatum* Snyder
Fig. 3.—*Kalotermes* (*Calcaritermes*) *guatemalae* Snyder

Type locality.—Hamburg Farm, Santa Clara Province, Costa Rica.

Described from a series of winged adults and soldiers collected with nymphs of the sexual form at the type locality on January 22, 1925, by Mr. F. Neverman in dead hardwood of Manic.

Co-types, winged adult.—Cat. No. 28655, U. S. N. M.; co-morphotypes, soldier.

The winged sexual adults of *K.* (*R.*) *costaricensis* are large and bicolored; and the soldier is also large.

Kalotermes (*Calcaritermes*) **asperatum,** new species

Winged adult.—Head castaneous-brown (lighter posteriorly and below eyes) smooth, shining, longer than broad, elongate, sub-oval, rounded posteriorly, a V-shaped marking at epicranial suture, with scattered, fairly long hairs. Eyes black, not round, but little projecting, separated from lower

margin of head by a distance less than the short diameter of an eye. Ocelli hyaline, suboval, close to eye.

Antenna light yellow-brown, with 12 segments, with long hairs; third segment subclavate, slender, longer than second or fourth segments; fourth segment bead-like; from fourth on segments becoming longer and broader toward apex; last segment elongate, slender, subelliptical.

Pronotum same color as head, shallowly concave anteriorly; posterior margin convex except for median emargination; sides narrow posteriorly; pronotum with scattered, long hairs.

Wings smoky, costal area darker (brown); tissue coarsely punctate; in forewing, median vein close to and parallel to subcosta; cubitus nearly in center of wing branching to apex, with about 11 to 12 branches or sub-branches to lower margin of wing; in hind wing, median branching from subcosta near base of wing.

Legs yellow (femora darker), slender, elongate; pulvillus present; legs with long hairs.

Abdomen with tergites castaneous-brown, a row of long hairs at base of each; cerci short, broad at base; styli present.

Measurements.—Length of entire winged adult, 5.8–6.2 mm.; length of entire deälated adult, 3.6 to 3.7 mm.; length of head (posterior margin to tip of labrum), 1.05 mm.; length of pronotum, 0.5–0.6 mm.; length of forewing, 4.2–4.3 mm.; length of hind tibia, 0.75–0.8 mm.; diameter of eye (long diameter), 0.25 mm.; width of head (at eyes), 0.75 mm.; width of pronotum, 0.7 mm.; width of forewing, 1.4 mm.

Soldier.—Head light castaneous-brown (with reddish tinge) to piceous on front (paler posteriorly), in profile head slightly concave in middle, short, cylindrical, front vertical to slightly projecting (overhanging) dorsally; head constricted (narrowed) dorsally at front, front scooped out; head with deep V-shaped median suture, lobes elevated, broadly rounded, and markedly roughened (tuberculate); head with transverse rows of long hairs anteriorly and in middle.

Eye spot not distinct, suboval. Gula blackish, not much narrowed in middle.

Mandibles blackish, short, broad at base, but pointed and incurved at apex; left mandible with two pointed marginal teeth near apex and a broad molar in middle; right mandible with two sharp-pointed teeth in middle (Fig. 2).

Antenna yellow-brown, with 10 segments, segments becoming longer and broader toward apex, with long hairs; third segment narrow, short, shorter than second or fourth segments; last segment slender, elongate, subelliptical.

Pronotum of same color as head; anterior margin deeply and roundly concave, roughened, with minute serrations or denticules; anterior corners high; posterior margin straight, except for median, round emargination; sides angularly narrow posteriorly.

Presternal processes dark colored.

Legs tinged with yellow; femora swollen; two chitinized spines and a spur at base of fore tibiae.

Abdomen with tergites yellowish, with a row of long hairs at base of each; cerci short.

Measurements.—Length of entire soldier, 3.8–4.7 mm.; length of head with mandibles, 1.55–1.75 mm.; length of head without mandibles (to anterior margin), 1.2–1.4 mm.; length of left mandible, 0.6 mm.; length of pronotum,

0.55–0.6 mm.; length of hind tibiae, 0.6 mm.; width of head (anteriorly), 0.85–1 mm.; width of head (posteriorly), 1–1.1 mm.; height of head at middle, 0.9–1. mm.; width of pronotum, 0.9–1 mm.

Type locality.—Hamburg Farm, Santa Clara Province, Costa Rica.

Described from a series of winged adults and soldiers collected with nymphs at the type locality by F. Neverman on May 15, 1925, in heartwood.

Co-type, soldiers.—Cat. No. 28656, U. S. N. M.; co-morphotypes, winged adult.

Kalotermes. (*C.*) *asperatum* is smaller than either *K.* (*Calcaritermes*) *imminens* Snyder and *recessifrons* Snyder from Colombia or *guatemalae* Snyder from Guatemala and Costa Rica.

Kalotermes (*Calcaritermes*) **guatemalae,** new species

Winged adult.—Head very dark castaneous-brown (with reddish tinge), (lighter below the eyes and anteriorly), smooth, shining, longer than broad, (broadly suboval), rounded posteriorly, with few scattered short hairs, and a row of long hairs posteriorly. Eye black, not round, projecting, separated from lower margin of head by a distance about equal to half the short diameter of an eye. Ocellus hyaline, suboval, very close to eye.

Antenna yellow-brown near base, whitish with yellow tinge towards apex, with 13 segments; segments wedge-shaped to bead-like, becoming longer and broader toward apex; with long hairs; third segment subclavate, longer than fourth segment but approximately subequal to second; last segment elongate, subelliptical.

Pronotum of same color as head; anterior margin broadly roundly emarginate (shallowly concave); anterior corners high; sides roundly narrow towards posterior margin, which is nearly straight; short hairs on anterior margin; a row of long hairs just posteriorly to middle and on posterior margin.

Wings dusky brown (smoky), costal veins darker; membrane coarsely punctate; in forewing, median vein close and parallel to subcostal vein; cubitus in about middle of wing, branching to apex with about 12 branches or sub-branches to lower margin; in hind wing, median originates from subcosta near apex.

Legs with coxae and femora dark castaneous-brown; tibiae and tarsi white with yellow tinge; legs slender and elongate.

Abdomen with tergites dark castaneous-brown, with a row of long hairs at base of each; cerci fairly prominent; styli present.

Measurement.—Length of entire winged adult, 8–8.25 mm.; length of entire deälated adult, 5 mm.; length of head (posterior margin to tip labrum), 1.4–1.45 mm.; length of pronotum, 0.7 mm.; length of forewing, 5.75 mm.; length of hind tibia, 1.1 mm.; diameter of eye (long diameter), 0.275 mm.; width of head (at eyes), 1.15–1.2 mm.; width of pronotum, 1–1.05 mm.; width of forewing, 1.8 mm.

Soldier.—Head castaneous-brown (lighter posteriorly and darker—to piceous—at anterior margin), elongate, cylindrical, thick, wider posteriorly than anteriorly, concave (dorsally) in middle in profile; head longer ventrally (2.40 mm.)—projecting to post-clypeus—than dorsally (2.25 mm.), where vertical; epicranial suture concave (hollowed out); head lobed medianly, a broad U-shaped cleft or suture, lobes but slightly roughened; head with few scattered long hairs. Eye spot hyaline, large, suboval, separated from antennal socket by a distance equal to its long diameter. Gula narrowed in middle.

Mandibles piceous, broad at base, sharp-pointed and incurved at apex; left mandible with three sharp-pointed marginal teeth, two near apical third, the other, larger tooth near middle; right mandible with two large pointed teeth near middle (fig. 3).

Antenna light yellow-brown near base (lighter anteriorly), with 12 segments; segments wedge-shaped, becoming longer and broader toward apex, with long hairs; third segment short, ring-like, shorter than second or fourth segments; last segment short, slender, suboval.

Pronotum castaneous-brown (margins darker), similar in shape to that of *K.* (*C.*) *emarginicollis* Snyder, but not quite so emarginate posteriorly, with scattered long hairs.

Legs tinged with yellow (femora darker and swollen); fore tibiae with spur.

Abdomen with tergites dirty white, tinged with yellow, a row of long hairs at base of each; cerci small; styli present.

Measurements.—Length of entire soldier, 6.5–7.5 mm.; length of head with mandibles, 3 mm.; length of head without mandibles (to anterior margin), 2.4 mm.; length of left mandible, 1 mm.; length of pronotum, 0.8–0.9 mm.; length of hind tibia, 0.9 mm.; width of head anteriorly, 1.5 mm.; width of head posteriorly, 1.7 mm.; height of head at middle, 1.4–1.5 mm.; width of pronotum, 1.5 mm.

Type locality.—Mixco, Guatemala.

Described from a series of winged adults collected with soldiers and nymphs at the type locality in May, 1924, by D. W. M. Mann. Other specimens of this termite (winged adults and soldiers) collected at Estrella, Costa Rica, in April, 1924, by Mann and soldiers at Bananito on April 20, 1925, by F. Neverman.

Co-type, soldier.—Cat. No. 28657 U. S. National Museum; co-morphotypes winged adult.

The soldier of *K.* (*C.*) *guatemalae* is similar to that of *K.* (*C.*) *emarginicollis* Snyder from Panama, but it is darker colored, larger, and has a wider head and a longer, and less deeply emarginate pronotum.

Kalotermes (*Calcaritermes*) **thompsonae,** new species

Winged adult.—Head yellow-brown or light castaneous-brown (slightly immature), shining, sides parallel, approximately suboval, with scattered short hairs and row of longer hairs posteriorly. Eye black, not round, projecting, separated from lower margin of head by a distance less than long diameter of eye; ocellus hyaline, suboval, close to and at an oblique angle to eye.

Antenna light yellow-brown at base, yellow at apex, with 13 segments, segments wedge-shaped, becoming longer and broader toward apex, with long hairs; third segment subclavate, longer than second or fourth segments; last segment elongate, narrow, subelliptical.

Pronotum of same color as head, broadly and roundly concave anteriorly; posterior margin nearly straight; sides angularly narrow posteriorly; margins with scattered short and long hairs.

Wings hyaline (slightly immature) costal area yellow-brown; membrane coarsely punctate; in forewing, median vein close to and parallel to subcosta; cubitus in about middle of wing, branching to apex of wing; with 11–12 branches or sub-branches to lower margin of wing; in hind wing, median originating from subcosta near base.

Legs yellow, elongate, slender, pulvillus present, hairs long.

Abdomen with tergites light yellow-brown, a row of long hairs at base of each tergite; cerci short.

Measurements.—Length of entire winged adult, 7–7.5 mm.; length of entire deälated adult, 4.3–4.6 mm.; length of head (posterior margin to tip of labrum), 1.15–1.2 mm.; length of pronotum, 0.5–0.55 mm.; length of forewing, 5.4 mm.; length of hind tibia, 0.7 mm.; diameter of eye (long diam.), 0.25 mm.; width of head (at eyes), 0.9 mm.; width of pronotum, 0.85 mm.; width of forewing, 1.5 mm.

The winged adult of *K.* (*C.*) *thompsonae* is lighter colored and smaller than either *imminens* Snyder or *recessifrons* Snyder from Colombia.

Soldier.—Head castaneous to piceous on front, and yellow posteriorly, semicylindrical, nearly straight in profile, longer ventrally than dorsally; front of head with oblique slope, ventrally, seen from front, more or less shallowly concave, only slight outlines of a rim about median suture, which is broad, shallow, and V-shaped, lobes rounded and slightly roughened, with scattered short hairs anteriorly and a row of long hairs posteriorly. Eye spot indistinct. Gula narrowest at middle (where broadest in *K.* (*C.*) *recessifrons* Snyder from Colombia).

Mandibles piceous, short, broad at base, pointed and incurved at apex; left mandible with two sharp-pointed marginal teeth at apical third, another in middle; right with two larger pointed marginal teeth near middle.

Antenna light yellow-brown, with 11 segments, segments wedge-shaped, becoming longer and broader toward apex, with long hairs; third segment ring-like, shorter than second or fourth segments; last segment slender, elongate, semi-elliptical.

Pronotum light yellow-brown (margins darker), short, nearly twice as broad as long; anterior margin broadly, roundly concave; anterior corners high; posterior margin shallowly concave in center; sides nearly straight, narrow posteriorly; pronotum with but few scattered short hairs and a row of longer hairs posteriorly.

Presternal processes dark (yellow-brown).

Legs yellow, femora swollen, spur on fore tibiae.

Abdomen with tergites tinged with yellow, with a row of long hairs; cerci short.

Measurements.—Length of entire soldier, 4 mm.; length of head with mandibles, 1.8 mm.; length of head without mandibles (to anterior margin ventrally), 1.5 mm.; length of left mandible, 0.55 mm.; length of pronotum, 0.5 mm.; length of hind tibia, 0.55 mm.; width of head anteriorly, 0.9 mm.; width of head posteriorly, 0.95 mm.; height of head (at middle), 0.8 mm.; width of pronotum, 0.9 mm.

Type locality.—Hamburg Farm, Santa Clara Province, Costa Rica.

Described from a series of winged adults and a soldier collected with nymphs at the type locality on May 29, 1925, by F. Neverman in dead dry-wood of standing tree.

Co-type, soldier—Cat. No. 28658 U. S. National Museum; co-morphotypes winged adult.

The soldier of *K.* (*C.*) *thompsonae* has a shorter, more pointed mandible than in *recessifrons* Snyder and a shorter pronotum; it is smaller than *emarginicollis* Snyder from Panama.

Named in honor of the late Dr. C. B. Thompson of Wellesley College.

Kalotermes (*Glyptotermes*) **marlatti,** new species

Winged adult.—Head light castaneous-brown, punctate, shining, sides parallel; head suboval, with scattered long hairs. Eye black, not round, projecting, separated from lower margin of head by a distance less than the diameter of an eye. Ocellus hyaline, suboval, close and at an oblique angle to eye.

Antenna yellow-brown, with 11 segments, segments bead-like, becoming longer and broader toward apex, with long hairs; third segment subclavate, slightly longer than second or fourth segment; last segment elongate, subelliptical.

Pronotum of same color as head, broadly roundly concave anteriorly; anterior corners high; straight at posterior margins; sides angularly narrowed posteriorly; pronotum with scattered long hairs.

Wings dusky with golden tinge (costal area yellow-brown); tissue coarsely punctate; in forewing, median vein close to and parallel to subcosta; cubitus in about middle of wing, branching to apex, with about 12 branches or subbranches to lower margin; in hindwing, median originating from subcosta near base (at about basal fourth of wing).

Legs yellow, elongate, slender, with long hairs.

Abdomen with tergites castaneous-brown, with a row of long hairs at base of each; cerci short.

Measurements.—Length of entire winged adult, 6.2 mm.; length of entire deälated adult, 4.5 mm.; length of head (posterior margins to tip of labrum), 0.9 mm.; length of pronotum, 0.45 mm.; length of forewing, 4.5 mm.; length of hind tibia, 0.6 mm.; diameter of eye (long diameter), 0.225 mm.; width of head (at eyes), 0.75 mm.; width of pronotum, 0.65 mm.; width of forewing, 1.2 mm.

The winged adult of *K.* (*G.*) *marlatti* is lighter colored than that of *barbouri* Snyder of Panama.

Soldier.—Head light castaneous-brown (darker—piceous—anteriorly and lighter posteriorly), slightly concave in middle in profile, slightly longer ventrally than dorsally, markedly narrowed or constricted dorsally at front, front darker, nearly vertical, a deep U-shaped median suture, lobes darker, raised and slightly roughened; head with two transverse rows of long hairs. Eye spot hyaline, suboval. Gula narrowed at middle.

Mandibles piceous, short, broad at base, sharp and incurved at apex; left mandible with two sharp-pointed marginal teeth on apical third, another near middle; right mandible with two larger, pointed teeth near middle.

Antenna light yellow-brown, with 10–11 segments, segments wedge-shaped, becoming longer and broader toward apex, with long hairs; third segment small, ring-like; last segment slender, elongate, subelliptical.

Pronotum of same color as head, broadly roundly concave anteriorly, nearly straight at posterior margin, anterior corners high, sides narrow posteriorly, margins with long hairs.

Presternal processes light yellow-brown.

Legs yellowish, femora swollen, three castaneous chitinized spines at base of fore tibiae; legs with long hairs.

Abdomen with tergites dirty gray-white with yellowish tinge, with a row of long hairs on each; cerci fairly elongate.

Measurements.—Length of entire soldier, 4.25 mm.; length of head with mandibles, 1.65 mm.; length of head without mandibles (to anterior margin), 1.25 mm.; length of left mandible, 0.55 mm.; length of pronotum, 0.5 mm.; length of hind tibia, 0.5 mm.; width of head anteriorly, 0.75 mm.; width of

head posteriorly, 0.85 mm.; height of head (at middle), 0.75 mm.; width of pronotum, 0.8 mm.

Type locality.—Hamburg Farm, Santa Clara Province, Costa Rica.

Described from a winged adult and a soldier collected at the type locality by F. Neverman, February 1, 1925, in hardwood of Manú.

Co-type, soldier.—Cat. No. 28659 U. S. N. M.; co-morphotype, winged adult.

The soldier of *K.* (*G.*) *marlatti* is smaller than that of *angustus* Snyder of Panama; is close to *barbouri* Snyder but the head is not so high, and the marginal teeth on the left mandibles are sharp pointed and not molar, and also the pronotum is of slightly different shape.

Named in honor of Dr. C. L. Marlatt of the Federal Horticultural Board who carefully guards the United States against importation of foreign termites.

Kalotermes (*Glyptotermes*) **nevermani,** new species

Soldier.—Head light yellow, darker (yellow-brown) anteriorly, longer than broad, cylindrical, only slightly broader posteriorly than anteriorly, front obliquely, angularly sloping, a broad, rounded suture medianly, margins of lobes rounded, but slightly roughened, slightly elevated; head with several transverse rows of long hairs. Eye spot hyaline, large, suboval. Gula elongate, about half as wide in middle as where widest anteriorly.

Mandibles dark reddish-brown to piceous at tips, broad, narrowed, pointed and incurved at tips; left mandible with one pointed marginal tooth near apex, a molar with sharp point anteriorly and broader molar; right mandible with sharp-pointed tooth near middle and molar about as in *K.* (*G.*) *suturis* Snyder.

Antenna light yellow, (darker near base), with 10 to 12 segments, usually 11, segments becoming longer and broader (wedge-shaped) toward apex, with long hairs; third segment short, ring-like, shorter than second or fourth segments; last segment slender, elongate, subelliptical.

Pronotum yellow (margins darker), broadly and shallowly concave anteriorly, posterior margin nearly straight, anterior corners high, sides angularly narrowed posteriorly; hairs scattered, and long.

Presternal processes yellow.

Legs whitish, tinged with yellow, femora swollen, with long hairs.

Abdomen gray-white, with a row of long hairs at the base of each tergite, cerci fairly elongate; styli present.

Measurements.—Length of entire soldier, 5–6.25 mm.; length of head with mandibles, 2.5–2.7 mm.; length of head without mandibles (to anterior), 1.8–1.9 mm.; length of left mandible, 0.95 mm.; length of pronotum, 0.6–0.7 mm.; length; of hind tibia, 0.9 mm.; width of head (dorsally) anteriorly, 1.2 mm.; width of head posteriorly, 1.25 mm.; height of head in middle, 1.2 mm.; width of pronotum, 1–1.05 mm.

Type-locality.—Western slope of the volcano Irazú, at 1500 meters, Costa Rica.

Described from three soldiers, collected with nymphs at the type locality by F. Neverman on February 22, 1925, in a dry stump.

Co-type, soldiers.—Cat. No. 28660 U. S. N. M.

Kalotermes (*G.*) *nevermani* is close to *K.* (*G.*) *suturis* Snyder, also from Costa Rica, but is larger and has more segments to the antenna; the winged adult is unknown.

Family TERMITIDAE

Capritermes (*Neocapritermes*) **longinotus,** new species

Soldier.—Head yellow to pale yellow-brown, darker anteriorly and on sides, with a distinct dark median line running from posterior margin to epicranial suture, sides nearly parallel, but head broader posteriorly than anteriorly, rounded posteriorly, with fairly dense long hairs, especially anteriorly. Labrum of same color as head, elongate and faintly trilobed, broad at apex, narrowed in middle, long hairs on median lobe. Gula elongate, slender, about half as wide in middle as where widest anteriorly. Mandibles black, twisted, asymmetrical; left mandible longer than right.

Antenna yellow, with 16 segments, segments becoming longer and broader toward apex, longest in middle; with long hairs; third segment shorter than second, but approximately subequal to fourth segment, or slightly shorter; segments becoming markedly longer from seventh to twelfth segments, then becoming shorter; last segment elongate, slender, subelliptical.

Pronotum white with tinge of yellow, darker on anterior margin, very elongate anteriorly, high (saddle-shaped), and markedly roundly emarginate, hairs dense, and long.

Legs tinged with yellow, elongate, slender, with long hairs.

Abdomen dirty white, tinged with yellow; tergites with fairly dense long yellow hairs; cerci not elongate.

Measurements.—Length of entire soldier, 7.75–8 mm.; length of head with mandibles, 4.6 mm.; length of head without mandibles (to anterior margin), 2.4 mm.; length of left mandible, 2.2 mm.; length of pronotum, 0.85 mm.; length of hind tibia, 1.25 mm.; width of head (anteriorly), 1.3 mm.; width of head (posteriorly), 1.4 mm.; height of head at middle, 1.2 mm.; width of pronotum: 1.05 mm.

Type locality.—Rio Frío, Colombia.

Described from four soldiers collected with workers by Dr. W. M. Mann in February, 1924, at the type locality.

Co-type, soldiers.—Cat. No. 28661, U. S. N. M.

Capritermes (*N.*) *longinotus* is a very small species with a narrow head and a very long pronotum, which is markedly roundly, emarginate anteriorly; the winged adult is unknown.

LIST OF KNOWN OR DESCRIBED TERMITES COLLECTED BY MANN AND NEVERMAN IN GUATEMALA, COSTA RICA AND COLOMBIA

Family KALOTERMITIDAE

Cryptotermes dudleyi Banks.

COSTA RICA:—San Jose, May 5, 1925, F. Neverman, colr. (winged adults flying at light in house)

Family RHINOTERMITIDAE

Coptotermes niger Snyder

Guatemala, Bobas; May, 1924, Dr. W. M. Mann, colr. (soldiers and workers).

COSTA RICA, Colombiana; March, 1924, Dr. W. M. Mann, colr. (soldiers and workers). Hamburg Farm, Feb., 1925, F. Neverman, colr. (soldiers and workers); June 2, 1925 (winged soldiers and workers). Bananito, April 20, 1925, F. Neverman, colr. (soldiers and workers).

Prorhinotermes molinoi Snyder
COSTA RICA, Parisiana Ranch; Feb. 6, 1925, F. Neverman, colr. (soldiers and workers in rotten log).

Family TERMITIDAE

Cornitermes acignathus Silvestri
COLOMBIA, Santa Anna; Feb., 1924, Dr. W. M. Mann, colr. (soldiers and workers).
Armitermes chagresi Snyder
COSTA RICA, Hamburg Farm; Jan., 1925, F. Neverman, colr. (soldiers and workers).
Nasutitermes (*Nasutitermes*) *columbicus* Holmgren
COSTA RICA, Hamburg Farm; Jan., 1925, F. Neverman, colr. (soldiers and workers).
Nasutitermes (*Nasutitermes*) *rotundatus* Holmgren
COLOMBIA, Rio Frio; March, 1924, Dr. W M. Mann, colr. (soldiers and workers).
Nasutitermes (*Obtusitermes*) *panamae* Snyder
COLOMBIA, Rio Frio; Feb., 1924, Dr. W. M. Mann, colr. (two types of soldiers and workers).
Amitermes beaumonti Banks
GUATEMALA, Mixco; May, 1924, Dr. W. M. Mann, colr. (soldiers and workers).
Microcerotermes exiguus Hagen
COLOMBIA, Santa Anna; Feb., 1924, Dr. W. M. Mann, colr. (queen, soldiers and workers).

SCIENTIFIC NOTES AND NEWS

The following lectures have been given in the Carnegie Institution's series since the last record in this JOURNAL: November 24, DR. ARTHUR L. DAY of the Geophysical Laboratory, *The Santa Barbara earthquake;* December 1, DR. HARALD U. SVERDRUP of Captain Amundsen's "Maud" Arctic-Drift Expedition, cooperating with the Department of Terrestrial Magnetism, *The scientific work of the "Maud" expedition, 1922–1925;* December 8, DR. ARTHUR S. KING of the Mount Wilson Observatory, *Laboratory methods of analysing spectra, with application to atomic structure.*

ERNEST F. BURCHARD of the U. S. Geological Survey has returned from a trip across South America from the Pacific to the Atlantic Coast, having examined iron-ore deposits in Misiones Territory and in Catamarca Province for the Argentine Government. On his return journey he visited the principal iron and manganese-ore deposits in central Minas Geraes, Brazil.

T. S. LOVERING has been appointed Junior Scientist in the Geological Survey.

The 1925 exhibition of current scientific work of the Carnegie Institution of Washington held during December 11 to 14 was attended by over 2,300 visitors. The exhibits shown may be classed into four groups: (1) Original materials or photographs of such materials on which research work was done; (2) methods, especially instrumental, for solving such problems; (3) models and simple experiments illustrating the principles on which a research problem is based; (4) tables, graphs, models, and other means of presenting results obtained by research work.